Virginia City Hybrid Energy Center
Response to Data Request
Bruce Buckheit, Member, Virginia Air Pollution Control Board

Question (Page No. 8):

Presumably (but not necessarily) the toxic metals that are emitted will be more bioavailable than they were in the waste piles. Please quantify if possible and, with respect to mercury provide modeling estimates of the increase in Hg dispersion in the local environment (within 75 miles of the plant) associated with burning unwashed coal and waste materials at the rates suggested by Dominion and as those might be affected by the control efficiency issue discussed above.

Response:

Combustion of waste coal piles will vaporize the mercury and other hazardous air pollutant (HAP) metals. Due to the relatively low exhaust gas temperatures (~170º F), it is expected that the non-mercury HAP metals will not be in vapor form in the baghouse and thus, will be captured at rates above 99.9%. Mercury is expected to be captured at rates exceeding 98%.

Mercury and other HAP metals in the unregulated waste coal piles (those generated prior to the 1977 Surface Mine Control and Reclamation Act [SMCRA] of which there are hundreds within 50 miles of St. Paul) are currently bioavailable. These piles are leaching sediments containing HAP metals and acids into the surrounding watershed at very high rates. Both the Virginia Department of Mines, Minerals and Energy (DMME) and the Pennsylvania Department of Environmental Protection (PADEP) have stated that leaving abandoned waste coal piles in place is far more hazardous to the environment than excavating them and burning the waste coal and properly disposing of the ash. John Meehan, the Reclamation Coordinator for PADEP said that officials in Pennsylvania have stated that abandoned waste coal piles are an environmental disaster in Pennsylvania. He said the Reliant Seward facility near Johnstown, Pennsylvania has been one of the most beneficial environmental projects in Pennsylvania due to its consumption of waste coal, not to mention its ability to generate electricity. According to Mr. Meehan, Pennsylvania has approximately 3,000 miles of streams that are dead due to leachate from abandoned coal piles.

Appalachian Technical Services, Inc. (ATS) conducted a study in September 2007 on the sediment leaching potential of an 11 acre abandoned waste coal pile in Wise County, Virginia. The study states:

> "The coal refuse material remaining in the pile is highly erodible, as depicted by the photographs of the large gully traversing the center of the

> pile. In places, this gully reaches up to 20 feet in depth and up to 40 feet in top width, with nearly vertical side slopes. Surveyed measurements of the gully indicate greater than 12.3 million kg (5.6 million lbs) of sediment has eroded from the gully since it was abaondoned for the second time in 1978. This volume does not account for the additional material that would have been transported from the adjacent watershed slopes or the material that is actively eroding from the area of the pile resting directly on the stream bank. Based on the gully volume alone and the period of time since the second abandonment (29 years ago), approximately 424,515 kg (192,611 lbs) per year total or 38,593 kg (17,510 lbs) per year per acre of sediment has eroded from this refuse pile. Transport of this material into Callahan Creek is evident from the photographs of the resulting delta of sediment which has built up in the stream where the gully empties into Callahan Creek.
>
> Based on the information given above we believe the environmental benefits of removing this material and restoring this hollow to its natural condition are obvious. Material removal will begin at the bottom of the pile adjacent to Callahan Creek. Once sufficient material has been removed, a sediment pond will be constructed to capture sediment generated by removal of the remaining coal refuse. NMS proposes to remove all the refuse material from the pile (with the possible exception of a small "island" to support an existing power line support) down to natural soil material. Where the coal content is high enough, the material will be sold as fuel. Otherwise, it will be disposed of in an existing adjacent refuse disposal facility. The area will then be vegetated and a stable stream channel will be re-established to carry runoff through the site."

Given that there are hundreds of waste coal piles in southwest Virginia and just one pile is leaching upwards of 192,611 lbs of sediment per year into the adjacent watershed, it seems apparent that the contaminants in the waste coal piles are far more bioavailable than if consumed in the highly controlled (98-99.9%) VCHEC boilers. Emissions calculations estimate that at maximum capacity (100% load for every hour of the year) VCHEC will emit just over 1 ton of HAP metals per year. The waste coal pile examined by ATS leaches over 96 tons of HAP-containing sediment, dissolved solids and acids into Callahan Creek annually. Considering the average GOB pile is approximately 4 acres (according to ATS) and there are roughly 400 waste coal piles within about 50 miles of St. Paul, waste coal piles are leaching 28 million pounds of sediment into the watershed annually. Air dispersion modeling has demonstrated that the HAP emissions from VCHEC are all more than 75% below Virginia's Significant Ambient Air Concentration (SAAC) and most are more than 99% below the SAAC. In addition, Dominion conducted a mercury deposition study to assess the potential long-term average incremental mercury water column concentration in the Clinch River due to atmospheric input from the proposed Virginia City Hybrid Energy Center (VCHEC) and its potential affect on mussel species in the closest river system, the Clinch River. The report (Attachment 1) concluded that "based upon these available data, there is no reason to believe that the endangered species of mussels in the Clinch River would be affected by the operation of the VCHEC."

ATTACHMENT 1

ATTACHMENT

Mercury Modeling in Clinch River Watershed

ENSR
2 Technology Park Drive, Westford, Massachusetts 01886-3140
T 978.589.3000 F 978.589.3100 www.ensr.aecom.com

Memorandum

Date: February 13, 2008

To: Bob Bisha / Dominion

From: David Heinold, Amanda MacNutt, Kristen Durocher / ENSR

Subject: Mercury Modeling in Clinch River Watershed

Distribution: Bill Campbell Steve Cibik Kim Lanterman

ENSR conducted a conservative screening-level modeling analysis to assess the potential long-term average incremental mercury water column concentration in the Clinch River due to atmospheric input from the proposed Virginia City Hybrid Energy Center (VCHEC). Incremental water concentrations were calculated for the Clinch River near the proposed VCHEC at a location that receives runoff from terrain to the east where maximum rates of deposition are predicted to occur. The analysis followed conservative assumptions recommended in the 2005 Final .S. EPA's Human Health Risk Assessment Protocol ("HHRAP"). HHRAP incorporates advances in science that the .S. EPA has made through conducting and reviewing risk assessments for combustion sources. Because it is part of a regulatory program, HHRAP includes conservative assumptions and methodologies to help ensure that estimates of media concentrations are conservatively high.

To conduct this assessment, the Industrial Risk Assessment Program (IRAP), which implements HHRAP guidance, was applied. IRAP is not a dispersion or deposition model, but uses externally estimated deposition rates. Air quality modeling for the proposed power plant has been conducted (by TRC) using CA P FF. The modeled concentrations for this project from the CA P FF simulations were applied to conservatively estimate mercury deposition on the Clinch River watershed. IRAP was then used to estimate the transport of mercury through the watershed and the resultant incremental concentration of mercury in the Clinch River.

. De ine the atershed upstream o the e posure point o interest

Figure 1 shows the extent of the Clinch River watershed upstream of VCHEC that was delineated for the analysis. The location in the watershed along the river which is closest to the proposed power plant is the point at which the mercury water column concentration was assessed. Note that predictions of deposition were only available for a portion of the upstream watershed located out to 42 km from the plant. The river receives runoff from the watershed located upstream of the plant and it would not be properly conservative to assume that the upper watershed received no mercury deposition. To account for this data gap, the model was adjusted to account for both rainfall-runoff and mercury deposition-washoff in the lower portion of the watershed. This produces estimates of streamflow and mercury loading that are consistent and likely overestimates final mercury concentration, because the upper watershed experiences similar runoff per unit of area to the lower watershed but receives lower incremental mercury loadings due to the distance from the plant.

. Compute the deposition o mercury on the atershed

Modeled annual average emission-normalized concentrations (i.e., for a 1 g sec emission rate) were obtained from TRC for three years (2001-2003). The CA P FF modeling used a rectangular nested grid with 100 m spacing out to 3 km, 250 m spacing out to 8 km, 500 m spacing out to 18 km, and 1km spacing out to 42 km (see Figure 2). IRAP requires that the watershed be represented by equally-spaced receptors in a rectangular grid so that it can calculate the total deposition on the watershed. This required that model results be selected from a subset of receptors modeled, spaced 1 km apart within the watershed area. Figure 3 depicts watershed, water body (Clinch River), and receptor locations used in IRAP. The risk receptor indicated in the figure denotes the location where IRAP calculated the total water column concentration. Note that because the maximum extent of the CA P FF receptors extended to 42 km, only the western half of the Clinch River watershed was modeled. As noted above this is not a significant limitation to this assessment because a compensating adjustment was made to watershed runoff, and the modeled concentrations are very small at 42 km and rapidly diminish with distance.

To compute deposition to the watershed IRAP requires the dry and wet long-term average emission-normalized deposition values for each watershed receptor. Although the effect of deposition is to attenuate the concentration with downwind distance, for this application it was conservatively assumed that there is no attenuation and that the long-term dry deposition rate to the watershed is equal to the long-term concentration multiplied by a deposition velocity of 2.9 cm sec, which is recommended by HHRAP. The technical discussion in HHRAP notes that value is an upper-limit estimate of the deposition velocity. To estimate long-term emission-normalized concentrations, the average CA P FF concentration at each watershed receptor was computed by averaging over the three modeled years.

Given that CA P FF also does not estimate wet deposition of mercury, wet deposition was estimated as a percentage of dry deposition. The ratio of wet to dry deposition is typically highest at receptors adjacent to tall stacks (where ground-level concentrations and dry deposition are negligible), but at greater distances, where the plume reaches the ground, the modeled wet mercury deposition is a small fraction of the modeled dry deposition. In this case the closest watershed receptors are about 2 km from the stack. In recent IRAP applications conducted by ENSR where both dry and wet mercury deposition was explicitly modeled, the wet deposition was only about 1 to 2% of the dry deposition at 2 km and beyond. To ensure conservatism for this application the wet deposition was set to 10% of the dry deposition.

. Compute mercury concentration in ater

In addition to the dry and wet deposition at each receptor, other site-specific input parameters entered into IRAP as required by HHRAP are listed in Table 1. The total mercury emission rate entered into IRAP is 72 lb year, which was provided by Bill Campbell (ENSR) and is based on proposed permit limits. This emission rate was then partitioned into elemental mercury (vapor) and divalent mercury (both vapor and particulate). Based on the EPRI publication, "An Assessment of Mercury Emissions from .S. Coal-Fired Power Plants" (EPRI. Technical Report 1000608, October 2000), Bill Campbell of ENSR indicated elemental mercury speciation for this project to be approximately 83% of the total mercury emissions. For the remaining 17% of mercury emissions which is in the divalent form, following the apportionment of divalent mercury emissions into particles and vapor by EPA in HHRAP, it was assumed that three-quarters of the emitted divalent mercury is vapor and one-quarter is particulate. HHRAP also establishes the fraction of each mercury species emitted that enters the global cycle and, therefore, is not subject to deposition. Table 2 shows the phase allocation and speciation of mercury in air as specified by HHRAP. The speciated mercury emissions input to IRAP (as computed in Table 2) are provided in Table 3. The resultant total incremental water column concentrations (average over 30 years and maximum after 30 years) of mercury modeled by IRAP at the risk receptor location shown in Figure 3 are provided in Table 4.

. Comparison o modeled incremental concentrations to ambient concentrations

In February, 2007, ENSR conducted a limited study of ambient conditions in the study area, including measurements of total and dissolved mercury concentrations in three samples collected from the Clinch River. These concentrations ranged from 4.25E-07 to 5.30E-07 mg (0.425 and 0.53 ng), two orders of magnitude higher than the incremental contribution modeled in IRAP. Table 5 summarizes the results of the modeled mercury concentrations, the ambient concentrations from February 2007, and theoretical total concentrations (ambient plus incremental) for both average and maximum conditions.

The lowest Virginia Water uality Standard (W S) for mercury is 50 ng (protective of public water supplies). For aquatic organisms, the W S is 770 ng of dissolved mercury in the water column. The calculated mercury concentrations in the Clinch River are lower than the public health criterion by two orders of magnitude and the aquatic life criterion by more than three orders of magnitude.

Concerns have been raised regarding the presence of state- and federally-listed mussels in the Clinch River. While few data are available that provide direct information on the toxicity of mercury to freshwater mussels, a review of literature from .S. EPA was conducted to determine whether or not the concentrations calculated for the Clinch River may put the endangered mussels at risk. The .S. EPA Ambient Water uality Criterion (AW C) document (1984) for mercury[1] and .S. EPA's online database (EcoTox[2]) were included in the review.

No toxicological data for freshwater mussel species were used in the derivation of the Final Chronic Value (FCV) in .S. EPA's 1984 AW C for mercury (1,302 ng)[3]. One genus of mollusk (*Amnicola* snails) was included in the FCV derivation the genus mean acute value for *Amnicola* was 7 of 28 genera (1 being most sensitive). The .S. EPA FCV is therefore likely protective of this group of mollusks.

The EcoTox database produced toxicological data records for two species of freshwater mussels. *Lamellidens marginalis* (Indian pearl mussel) was tested over durations of 4 and 5 days, exposed to unspeciated mercury and mercuric chloride, respectively. The C_{50} values (lowest concentration causing 50% mortality in exposed organisms) produced by these studies were 5,000 and 10,000 ug (5,000,000 and 10,000,000 ng) for the 4-day duration and 2,754 and 3,311 ug (2,754,000 and 3,311,000 ng) over the 5-day exposure duration. *Anodonta imbecillis* (the paper pondshell) was exposed for 2 and 4 days to mercuric chloride, with resulting C_{50} values from this study ranging from 216 to 233 ug (216,000 and 233,000 ng) for 2-day exposure and 147 to 171 ug (147,000 and 171,000 ng) for 4-day exposure. All these concentrations are at least five orders of magnitude higher than the calculated and observed concentrations of mercury in the Clinch River.

In addition to the direct toxicological effects from exposure to mercury, the potential for harmful effects from tissue residue was examined. Few data are available discussing uptake rates of mercury in freshwater mussels, and fewer data were available discussing the potential effects on freshwater mussels caused by a body residue of mercury. The Society of Toxicology and Chemistry (SETAC) published a database of critical body residues (CBRs)[4], and all studies included in the SETAC database have been peer-reviewed.

Two relevant studies on freshwater mussels were found in the SETAC database. *Pyganodon grandis* (giant floater) was exposed to 2.3 ng methylmercury in water for 88 days, with no adverse effects to survival, growth and reproduction noted. Tissues analyzed included mantle, foot, kidney, viscera and whole body. Tissue residue ranged from 0.04 to 0.08 ug g (converted from dry weight to wet weight assuming 80% water).[5] These tissue residue concentrations were also noted as no-effect concentrations. *Elliptio complanata* (Eastern elliptio) was exposed to 50,000 ng mercuric nitrate (inorganic mercury) in water for 60 days, with no adverse effects to survival, growth and reproduction noted. The soft tissue residue concentration (3.0 ug g converted from dry weight to wet weight assuming 80% water) was also noted as a no-effect concentration.

The readily available data for freshwater mussels exposed to mercury included two studies where no adverse effects were noted when mussels were exposed to 2.3 ng methyl mercury and 50,000 ng inorganic mercury. The study using inorganic mercury is most applicable to the Clinch River study, since ENSR s field collected surface water data indicated all mercury present in surface water from the river is in the inorganic form (methyl mercury was not detected). The study using inorganic mercury included endpoints for survival, growth, and reproduction and is therefore a strong indicator of no effects levels to freshwater mussels from exposure to

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[1] USEPA, Office of Water Regulations and Standards Division. Ambient Water Quality for Mercury-1984. January 1985.

[2] Available online [http://cfpub.epa.gov/ecotox/]

[3] The Final Chronic Value for mercury was not used for the actual AQWC in the 1984. The AWQC (12 ng/L) is based on bioaccumulation of mercury into freshwater fish.

[4] Jarvinen, A.W., Ankley, G.T. 1999. Linkage of Effects to Tissue Residues: Development of a Comprehensive Database for Aquatic Organisms Exposed to Inorganic and Organic Chemicals. Pensacola FL: Society of Environmental Toxicology and Chemistry (SETAC). 364pp

[5] Malley, D.F., A.R. Stewart and B.D. Hall, 1996. Uptake of Methyl Mercury by the Floater Mussel, *Pyganodon grandis* (Bivalvia, Unionidae), Caged in a Flooded Wetland. Environmental Toxicology and Chemistry 15(6): 928-936.

mercury. While species may differ in response to mercury exposure, exposure pathways for freshwater mussels are similar due to their feeding strategies. The mussel species used in the study, *Elliptio complanata* (Eastern elliptio), is a member of the nionidae family, which are generally filter feeders. Twenty-six unionid also inhabiting the Clinch River were indentified including 14 genera (Table 7). The unionid mussels found in the Clinch River are filter feeders, and therefore have similar feeding strategies and potential exposure pathways to mercury as *Elliptio complanata*. As *Elliptio complanata* does not appear to show mercury sensitivity to levels as high as 50,000 ng , other filter-feeding unionids are likely to show a similar response. Without actual toxicological data for the Clinch River mussels, it cannot be said deterministically that they will show no response to mercury at 50,000 ng , but they are unlikely to differ by more than an order of magnitude.

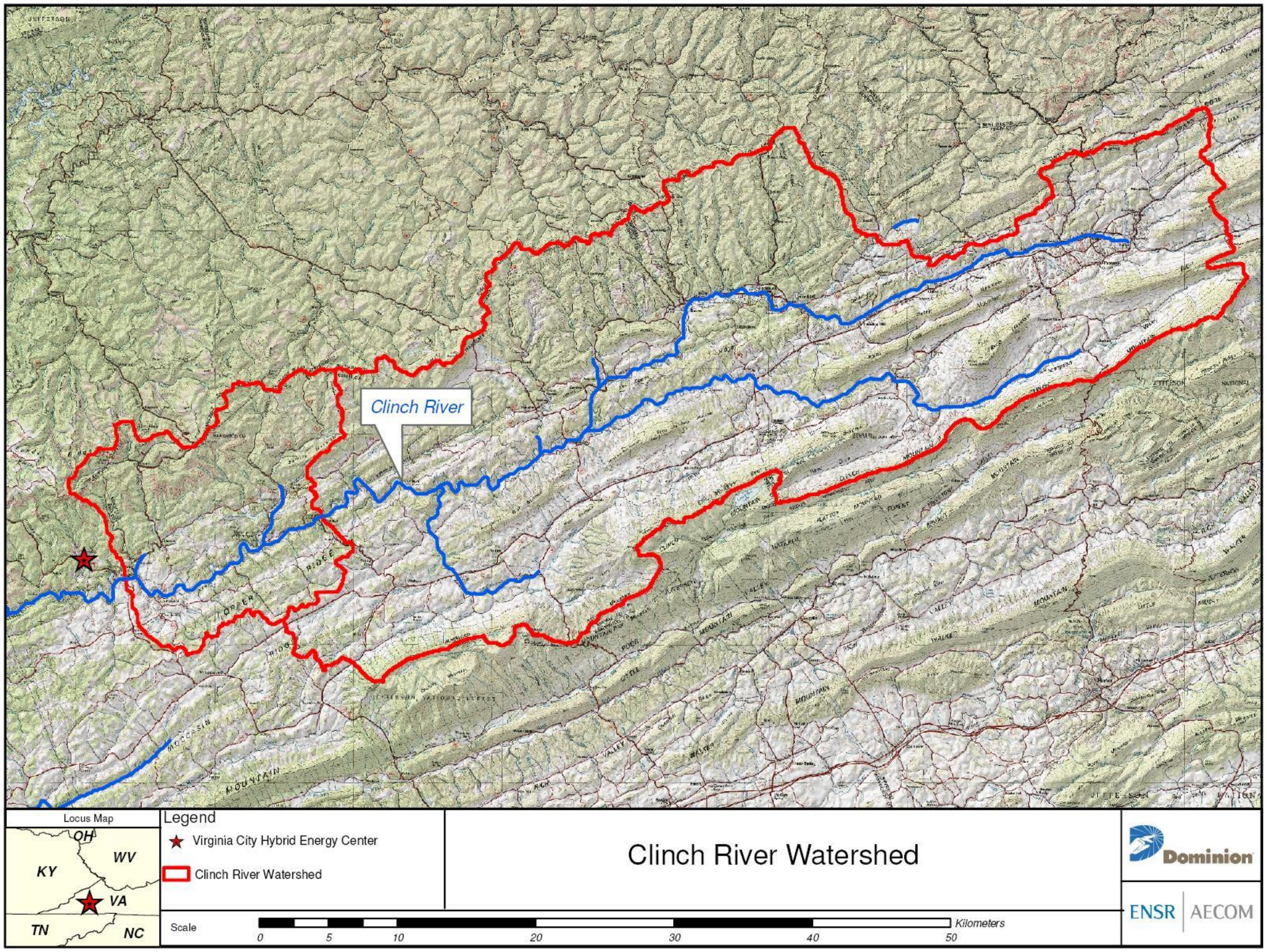
. ish Ad isories

No fish advisories for mercury are currently posted in the Clinch River. Virginia DE conducts fish tissue sampling studies on a regular basis to determine which of the waters in the state require fish advisories for mercury and other bioaccumulative compounds (e.g., PCBs). Mercury concentrations in fish tissue were available for three locations on the Clinch River from 1997, and two on the Clinch River from 2002. Concentrations of mercury in all the fish from these studies met the .S. EPA (2007) Methylmercury AW C for human health (0.3 mg kg methylmercury in fish tissue). A summary of the data is presented in Table 6. Additional data from the Guest River in the Clinch River Basin were found for 2003. These concentrations are similar to or lower than the data collected from the Clinch River in 1997 and 2002, and are presented for reference in Table 7.

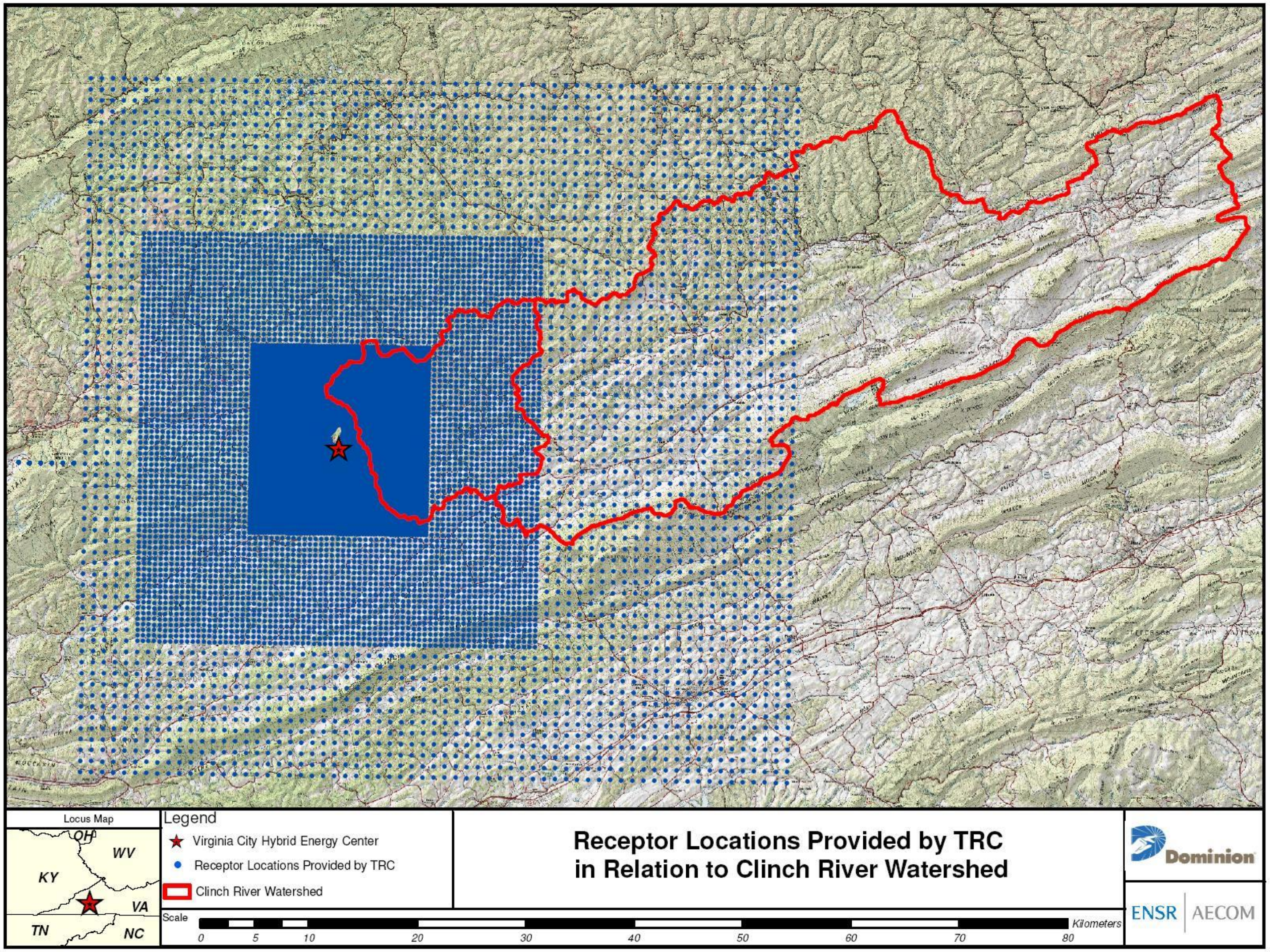
. ummary

Incremental contributions of atmospheric mercury to the Clinch River from the operation of the proposed VCHEC were conservatively estimated using a .S. EPA-approved model package. Modeled incremental concentrations were two orders of magnitude lower than current ambient conditions. These modeling results show that average mercury concentrations in the Clinch River will increase by less than one percent as a result of the operation of the VCHEC. Furthermore, available toxicological studies reveal that mussels with similar physiological characteristics to those in the Clinch River showed no effects to survival, growth, and reproduction when exposed to mercury concentrations approximately 100,000 times greater than those found in the Clinch River. Based upon these available data, there is no reason to believe that the endangered species of mussels in the Clinch River would be affected by the operation of the VCHEC.

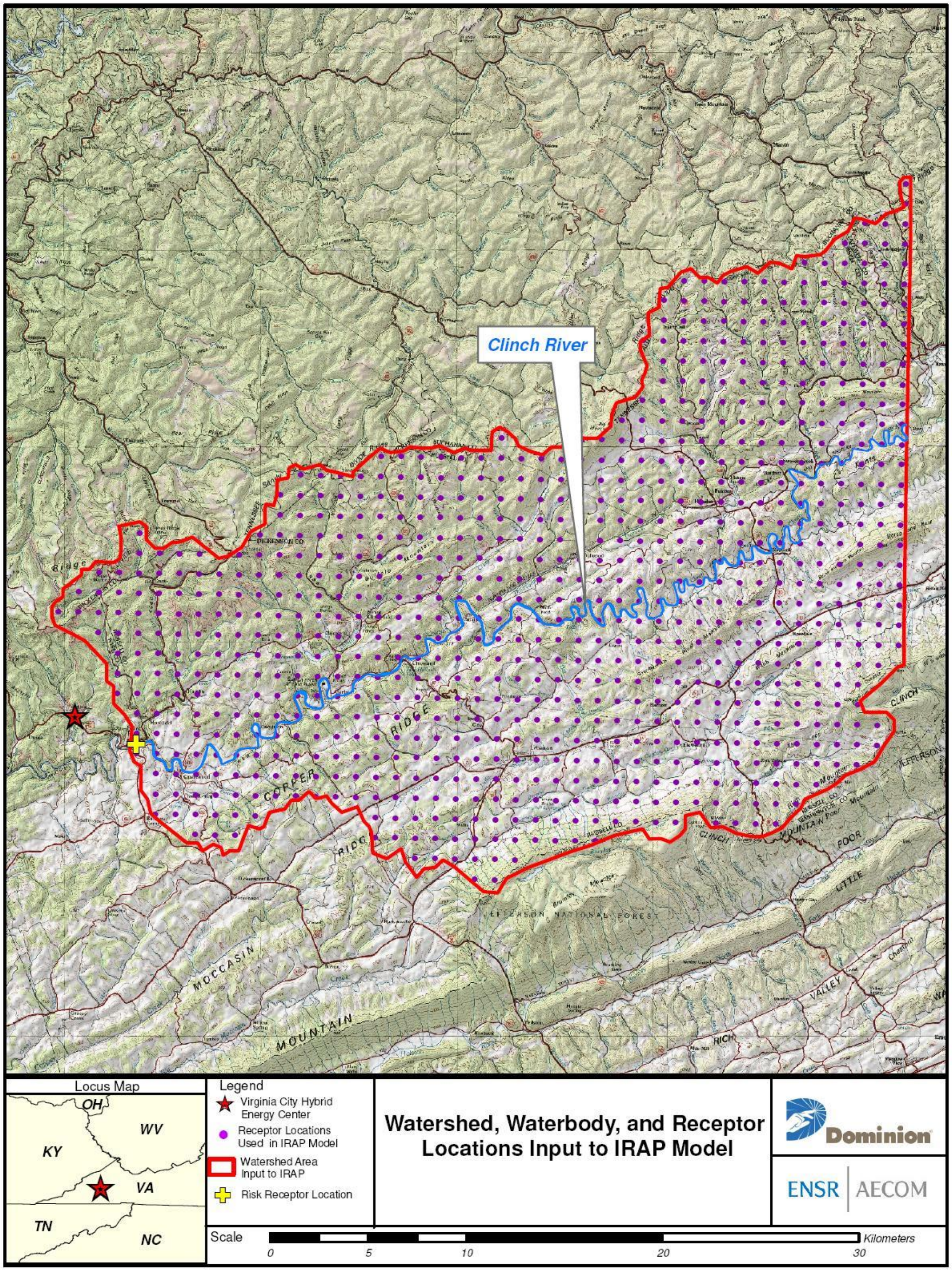
igure Clinch Ri er atershed pstream o VCHEC



igure Receptor ocations (Pro ided by RC) Relati e to Clinch Ri er atershed



igure atershed, aterbody, and Receptor ocation nput to RAP



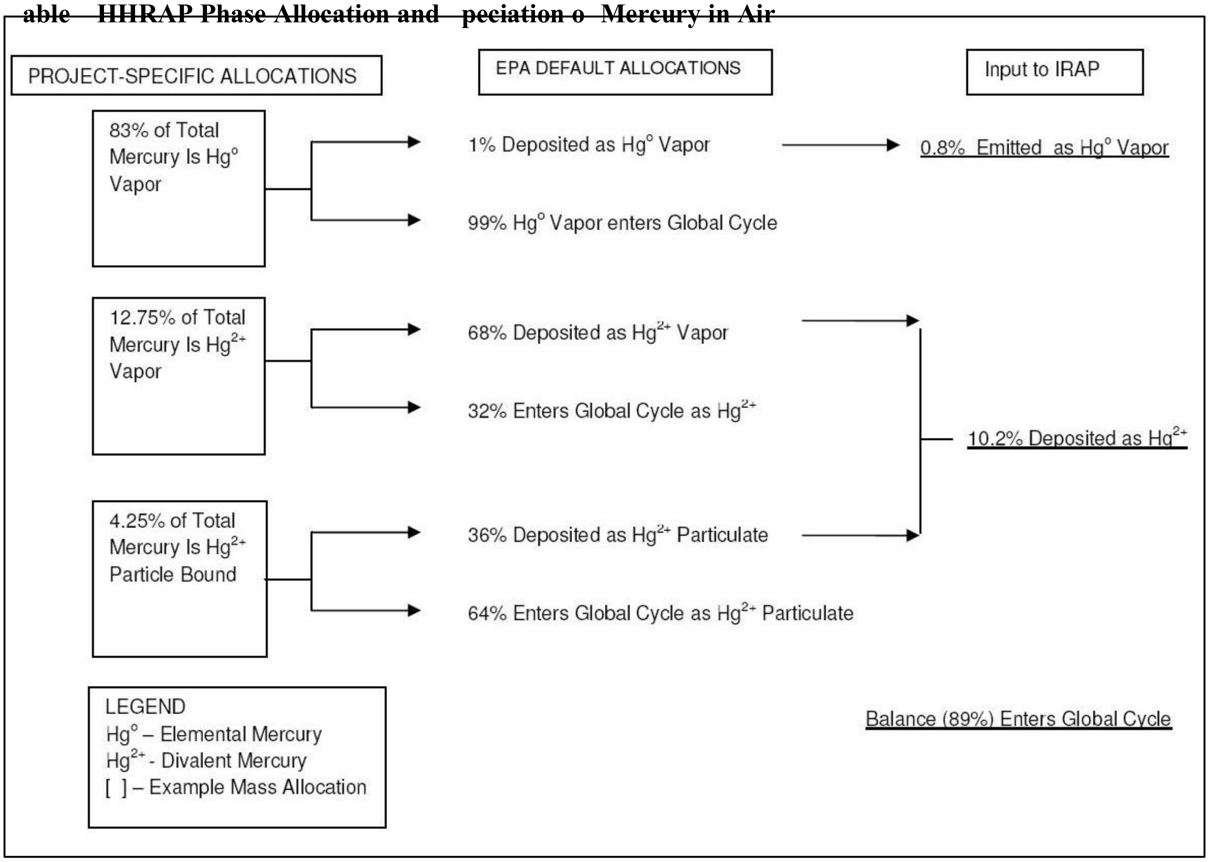
able ite speci ic Parameters nput to RAP

	Parameter	nits	Value	Re erence
eneral n ormation	Time of Deposition	(years)	30	sed in previous risk assessments.
	Average Annual Precipitation	(cm yr)	111.8	Climate of the nited States, Volume 2.
	Average annual surface runoff	(cm yr)	45.7	Georeferenced contours obtained electronically from SGS, developed from Average annual runoff in the nited States, 1951-80 Gebert, W. A. Graczyk, David J. rug, William R
	Average Annual Evapotranspiration	(cm yr)	26.5	From VA Climatology Office: Burkes Garden, 24.47 in yr total and Pennington Gap, 28.53 in yr total.
	Average Annual Irrigation	(cm yr)	1.1	Calculated based on Estimated Water se in the nited States, 2000. For the State of Virginia, irrigated land withdrawals were 29,600 acre-feet per year in 2000, with an application rate of 0.38 acre-feet per acre. This is based on a total irrigated land area of 78,200 acres in Virginia. Dividing the irrigate land water withdrawals by the total irrigated land area results in an average annual irrigation rate of 0.38 feet year, or 4.5 inches year.
	Rainfall Erosivity Factor	(year^{-1})	200	Wise County, VA averaged from R S E2, S Department of Agriculture.
	Average Annual Temperature at Bristol, TN	(^{o}C)	13.3	Climate of the nited States, Volume 2.
	Avg Annual Wind Speed at Bristol, TN	(m s)	2.5	Climate of the nited States, Volume 2.

able Cont.

Clinch Ri er	S E Cover Management Factor	unit less	0.1	EPA recommended value for grass and crops (HHRAP, 2005)
	Pervious Watershed Area	(m^2)	8.76E 08	Assuming 100% pervious
	Impervious Watershed Area	(m^2)	0.00E 00	Assuming 100% pervious
	Total Clinch River Watershed Area	(m^2)	8.76E 08	Delineated area around modeled receptors. Note that just the western portion of the actual watershed was used as modeled receptors did not extend through entire Watershed area.
	Average Clinch River Flow	(m^3 y)	5.98E 08	Period of record daily average flow recorded at Clinch River at Dungannon, SGS gage 03524000 711 cfs (6.25E08 m^3 year) as of April 2007.
	Clinch River Current Velocity	(m s)	0.36	Averaged cross-sectional velocity of 1.17 fps (0.36 m sec) from multiple measurements of water velocity at the Clinch River at Dungannon, SGS gage 03524000, between April 1999 and April 2007.
	Clinch River Surface Area	(m^2)	6.09E 06	Delineated area in IRAP, based on SGS 1:24,000 topographic map. Note that just the western portion of the river was used as modeled receptors did not extend through entire watershed area.
	Average ength of Clinch River	(m)	19697.0	Measured in GIS using SGS National Hydrologic Dataset 1:100 .
	Average Width of Clinch River	(m)	37.0	Average width of 122 feet (37.2 meters) from multiple measurements of water velocity in the Clinch River at Dungannon, SGS gage 03524000, between April 1999 and April 2007.
	Average Depth of Clinch River	(m)	1.4	Calculated by dividing the average cross-sectional area (53 square meters) by the average width (37.2 meters). The average cross-sectional area of 572 square feet (53 square meters) from multiple measurements of the wetted cross-section in the Clinch River at Dungannon, SGS gage 03524000, between April 1999 and April 2007.

able HHRAP Phase Allocation and peciation o Mercury in Air



able peciated Mercury Emissions sed in RAP to Compute Deposition

HAP	Emission Rate (g sec)
Elemental Mercury (Hg^0)	8.24E-06
Divalent Mercury (Hg^{2})	1.05E-04

According to calculations shown in Table 2, based on total Hg emission rate of 1.03E-03 g sec.

able ncremental Mercury Concentrations in ater Column rom RAP Model

	otal ater Column Concentration	
HAP	**A erage (mg ater)**	**Ma imum (mg ater)**
Mercury II (Inorganic Mercury)	3.27E-09	6.24E-09

(1) Concentration dissolved in water plus concentration associated with suspended solids

able Mercury Concentrations in ater Column

	otal ater Column Concentration	
ource o Mercury Concentration	**A erage (ng ater)**	**Ma imum (ng ater)**
IRAP (Inorganic Mercury)	0.00327	0.00624
February 2007 Sampling (Total Mercury)	0.478(2)	0.530
Total Mercury(3)	0.481	0.536

(1) Concentration dissolved in water plus concentration associated with suspended solids
(2) Average of both February 2007 samples from the Clinch River
(3) Sum of ambient concentrations and IRAP incremental concentrations.

able Mercury Concentrations in ish issue rom the Clinch Ri er

ear	ample ocation	ish pecies	N( )	Range o ength (cm)	Range o eight (g)	Mercury (mg kg)( )
1997	Clinch River near Clinchport [DE Rivermile 6BC N211.00]	Golden redhorse sucker	20	28.0-60.5	205-1830	0.30
		Rock bass	20	11.0-16.5	26.2-91.0	0.077
		ongear sunfish	11	9.0-13.5	13.2-70.2	0.061
		Smallmouth bass	8	13.5-30.5	35-200	0.15
		Gizzard shad	3	35.0-38.0	500-635	0.031
	Clinch River near Dungannon [DE Rivermile 6BC N236.00]	Golden redhorse sucker	2	30.0-31.5	280-700	0.11
		Gizzard shad	8	29.0-37.5	290-600	0.029
		Smallmouth bass	6	23.0-31.0	150-310	0.21
	Clinch River near Carbo [DE Rivermile 6BC N264.96]	Sunfish species	6	10.0-17.5	21.8-109.6	0.01
		Stoneroller	9	11.5-13.0	17.3-32.3	0.01
		Northern hogsucker	3	20.5-27.0	100-220	0.01
		Rock bass	13	13.5-19.5	51.5-135.8	0.14
		Golden redhorse sucker	2	35	310-570	0.063
2002	Clinch River near Dungannon [DE Rivermile 6BC N236.00]	Smallmouth bass	8	22.2-28.8	122-316	0.082
		Rock bass	5	19.2-22.0	152-212	0.066
		Rock bass	10	15.7-18.8	80-146	0.032
		Golden redhorse sucker	2	68.7-69.8	3608-3768	0.25
		Golden redhorse sucker	3	57.4-65.5	2340-3038	0.17
	Clinch River near Clinchport [DE Rivermile 6BC N211.00]	Smallmouth bass	5	24.5-32.7	186-402	0.14
		Rock bass	6	15.0-19.4	64-128	0.036
		Golden redhorse sucker	3	55.2-60.0	1798-2476	0.21
		Golden redhorse sucker	2	38.5-40.9	660-790	0.15

Notes:

All data obtained from VDE website [http: www.deq.virginia.gov fishtissue fishtissue.html]
(1) N number of individuals in sample
(2) Wet weight

able Mercury Concentrations in ish issue rom the uest Ri er

ear	ample ocation	ish pecies	N( )	Range o ength (cm)	Range o eight (g)	Mercury (mg kg)( )
2003	Guest River near Bangor near confluence with Clinch River [DE Rivermile 6BG E000.23]	Rock bass	3	17.8-21.3	98-200	0.076
		Redhorse sucker	5	39.0-43.5	418-632	0.243
		argemouth bass	1	26.5	220	0.236
	Guest River near Rt.72 bridge downstream of Coeburn [DE Rivermile 6BG E006.50]	Carp	1	73.5	6400	0.146
		Rock bass	3	18.0-22.0	120-222	0.107
		Smallmouth bass	5	24.4-27.2	182-256	0.119
		Northern hogsucker	5	27.6-31.3	240-384	0.093
	Guest River near Rt. 658 upstream of Coeburn [DE Rivermile 6BG E009.33]	Rock bass	4	14.1-17.8	60-114	0.105
		Redbreast sunfish	5	12.3-17.3	42-104	0.078
		Carp	1	54.7	2126	0.143
		Carp	1	63.5	3474	0.134
		Carp	1	56.7	2344	0.138
		Carp	1	50.5	1842	0.126
		Carp	1	63.7	4414	0.084
		Carp	1	59.0	2960	0.139
		Northern hogsucker	5	19.1-24.7	72-148	0.064
	Guest River near Tacoma [DE Rivermile 6BG E014.49]	Smallmouth bass	2	20.5-25.6	104-206	0.122
		argemouth bass	1	34.8	658	0.295
		Redbreast sunfish	5	15.3-17.7	76-112	0.073
		Carp	1	60.2	2894	0.108
		Carp	1	60.0	2714	0.147
	Guest River near Hawthorne [DE Rivermile 6BG E020.37]	Redbreast sunfish	4	15.1-18.2	72-134	0.067
		Rock bass	4	19.5-22.9	144-246	0.112
		Northern hogsucker	3	21.4-26.2	110-232	0.119
		Carp	1	65.1	4162	0.237
		Carp	1	56.9	2484	0.095
	Guest River near ipps [DE Rivermile 6BG E029.14]	Rock bass	5	16.9-20.4	100-162	0.079
		Northern hogsucker	7	15.0-17.9	30-58	0.050

Notes:

All data obtained from VDE website [http: www.deq.virginia.gov fishtissue fishtissue.html]
(1) N number of individuals in sample
(2) Wet weight

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pecies	tatus
Elliptio complanata	G5
Quadrula sparsa	G1, S1, E, E
Epioblasma florentina walkeri	G1T1, S1, E, E
Villosa trabalis	G1, S , E, E
Lemiox rimosus	G1, S1, E, E
Hemistena lata	G1, S1, E, E
Epioblasma brevidens	G1, S1, E, E
Dromus dromas	G1, S1, E, E
Cyprogenia stegaria	G1, S1, E, E
Fusconaia cuneolus	G1, S1, E, E
Epioblasma torulosa gubernaculums	G2T , S , E, E
Pleurobema collina	G1, S1, E, E
Pegias fibula	G1, S1, E, E
Epioblasma capsaeformis	G1, S1, E, E
Lampsilis abrupta	G2, S , E, E
Villosa perpurpurea	G1, S1, E, E
Pleurobema plenum	G1, SH, E, E
Quadrula cylindrica strigillata	G3T2, S2, E, E
Fusconaia cor	G1, S1, E, E
Villosa iris	G5
Medionidus conradicus	G3G4
Lasmigona holstonia	G3, S1, E
Pleurobema oviforme	G3, S2S3
Fusconaia barnesiana	G2G3, S2, SC
Lampsilis fasciola	G5
Ptychobranchus fasciolaris	G4G5

G1 Extremely rare and critically imperiled with 5 or fewer occurrences or very few remaining individuals or because of some factor(s) making it especially vulnerable to extinction.

G2 Very rare and imperiled with 6 to 20 occurrences or few remaining individuals or because of some factor(s) making it vulnerable to extinction.

G3 Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range or vulnerable to extinction because of other factors. sually fewer than 100 occurrences are documented.

G4 Common and apparently secure globally, although it may be rare in parts of its range, especially at the periphery.

G5 Very common and demonstrably secure globally, although it may be rare in parts of its range, especially at the periphery.

G G The rank is uncertain, but considered to be within the indicated range (e.g., G2G4) of ranks (also, T T).

G T Signifies the rank of a subspecies (e.g., G5T1 would apply to a subspecies if the species is demonstrably secure globally (G5) but the subspecies warrants a rank of T1, critically imperiled.)

S1 Extremely rare and critically imperiled with 5 or fewer occurrences or very few remaining individuals in Virginia or because of some factor(s) making it especially vulnerable to extirpation in Virginia.

S2 Very rare and imperiled with 6 to 20 occurrences or few remaining individuals in Virginia or because of some factor(s) making it vulnerable to extirpation in Virginia.

S3 Rare to uncommon in Virginia with between 20 and 100 occurrences may have fewer occurrences if found to be common or abundant at some of these locations may be somewhat vulnerable to extirpation in Virginia.

SH Formerly part of Virginia's fauna with some expectation that it may be rediscovered generally applies to species that have not been verified in the state for an extended period (usually 15 years) and for which some inventory has been attempted recently.

S Believed to be extirpated from Virginia with virtually no likelihood of rediscovery.

E isted Endangered. A taxon threatened with extinction throughout all or a significant portion of its range.

SC Special Concern animals that merit special concern according to the Virginia Department of Game and Inland Fisheries. This is not a legal category.